Illinois Department of Transportation

Memorandum

To:	ALL BRIDGE DESIGNERS	03.6
From:	Ralph E. Anderson	Ralph E. Anderson
Subject:	LRFD – End of Slab and Diaphragm Details	
Date:	October 1, 2003	

This memorandum is the fourth in a series detailing the Department's policies and procedures for implementation of the AASHTO LRFD Bridge Design Specification by October 1, 2007.

The current steel wide flange end diaphragms or a portion of the end cross frames are designed to resist the wheel load at the end of the slab in accordance with the AASHTO standard Specifications through the 2002, 17th edition. Use of a wide flange section has caused maintenance problems over the years. Water, soil and debris falling through failed joints collected on the back side of bottom flanges. This has caused the member to deteriorate.

Article 9.7.1.4 of the AASHTO LRFD Specifications has made it feasible for this Bureau to revise the end of concrete bridge slab details when there are expansion joints on LRFD projects. The details have been revised to incorporate use of a channel section to eliminate this problem. Additionally, the channel section allows access to the back face of the diaphragm during painting and inspection. These details are applicable to concrete slabs cast on steel plate girders and wide flange beams.

The new details utilize a channel section, with legs facing away from the abutment backwall. This channel section is now only designed to transfer wind loads from the superstructure to the end bearings and to support the concrete at the end of the bridge until it has cured. In eliminating this end member from carrying wheel loads, a concrete edge beam has been created to resist this load. See Figure 1.

Figures 2 and 3 present design charts for edge beams at ends of the concrete deck slab. These charts are based on the following criteria:

1) f'c = 3,500 ksi
2) fy = 60,000 ksi
3) Effective beam width = 21 inches
4) Beam height = 15 inches
5) Four reinforcement bars on the top and the bottom to develop the capacity.
6) Standard bar clearances for the slab.

7) Impact 75%
8) HL93 wheel loads used for live load, no lane load applied

With deeper sections, holes are required in the web of main stringers for the reinforcement to be continuous across the width of the deck. Reinforcement bars shall be spliced between beams with a Class C bar lap.

In addition to design charts, details for end diaphragms and cross frames have been revised for the change to channel sections. Those details are given in Figures 4 to 9.

To be consistent, interior diaphragms and cross frames have also been changed to utilize channel sections. Those revised details are presented in Figures 10 and 11.

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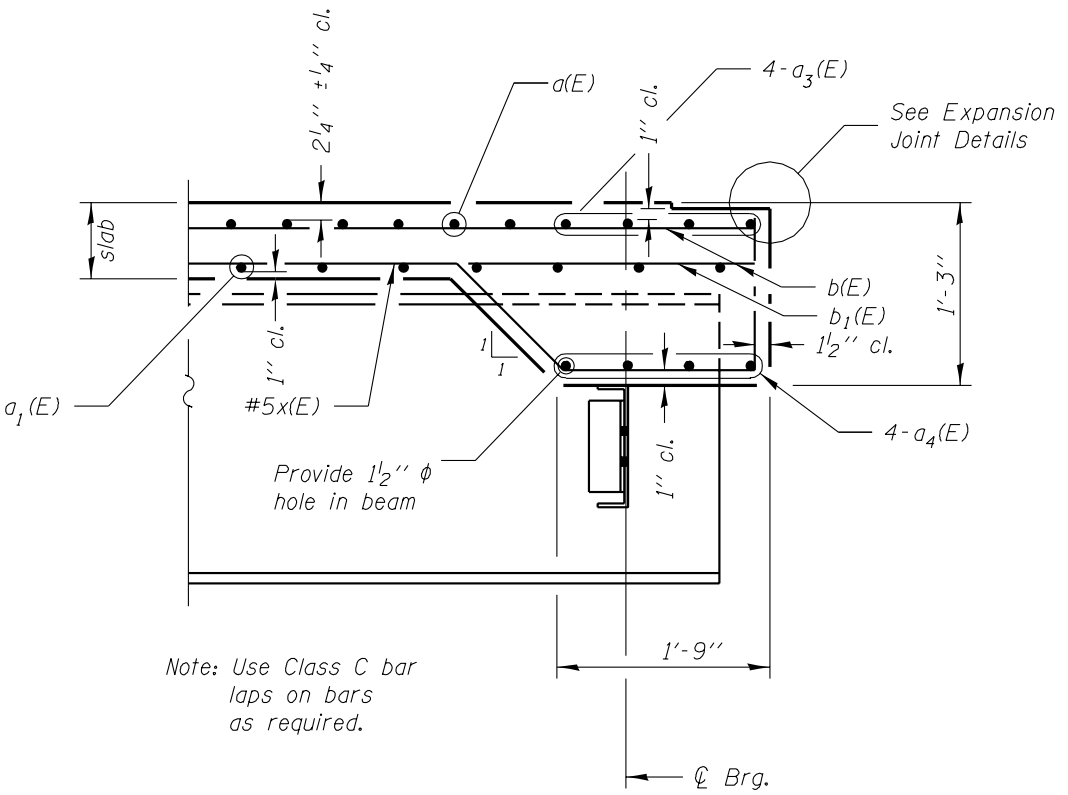
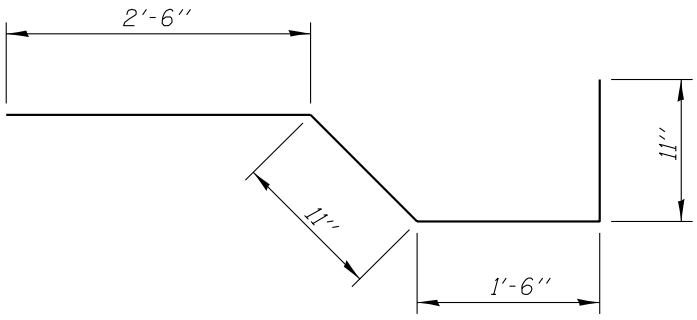


SECTION AT EXPANSION JOINT



BAR x(E)

EDGE BEAM AT EXPANSION JOINT

Figure 1

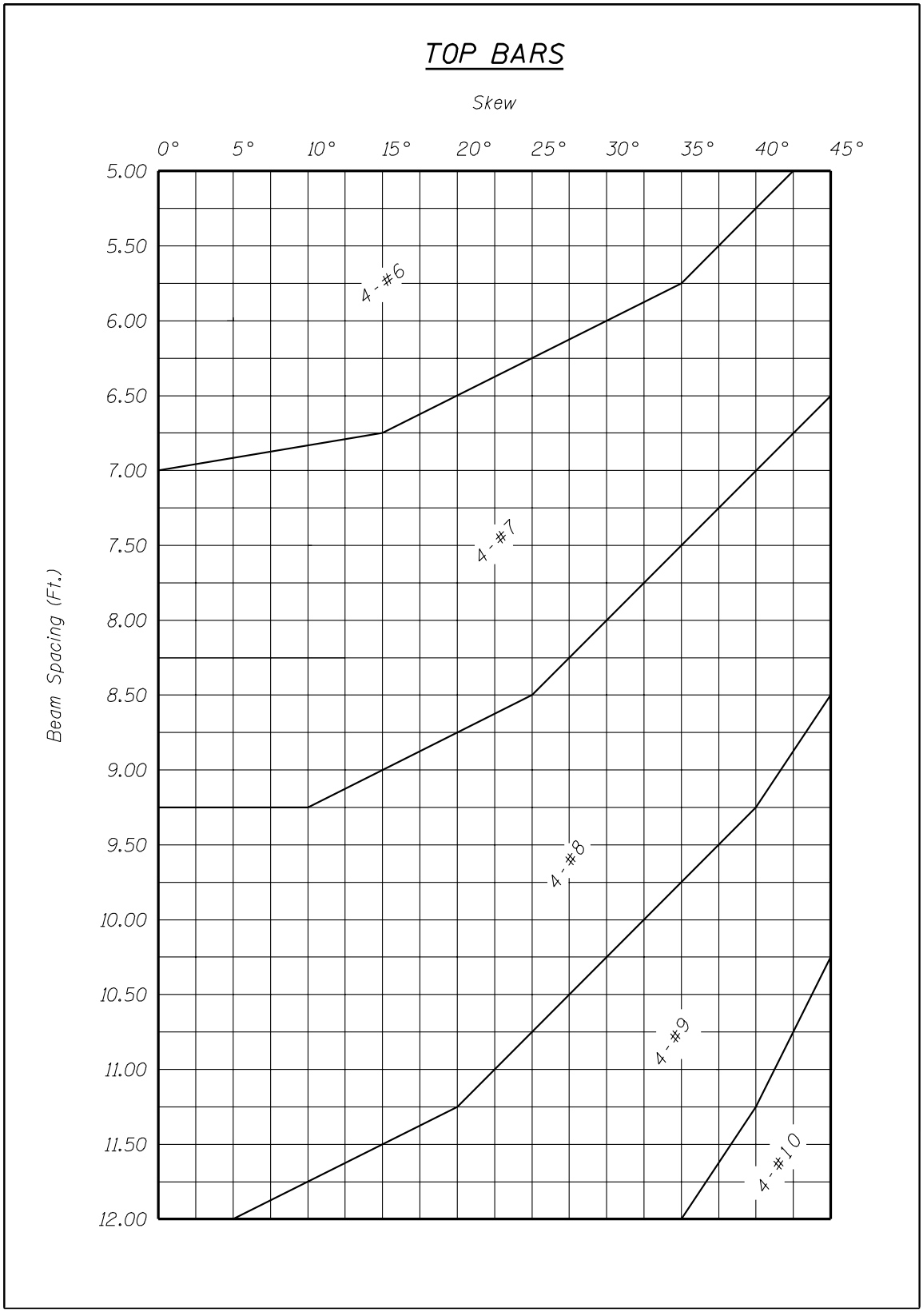

TOP BARS
Skew
0°
5°
10°
15°
20°
25°
30°
35°
40°
45°
Beam Spacing (Ft.)
5.00
5.50
6.00
6.50
7.00
7.50
8.00
8.50
9.00
9.50
10.00
10.50
11.00
11.50
12.00
4-#6
4-#7
4-#8
4-#9
4-#10

Figure 2

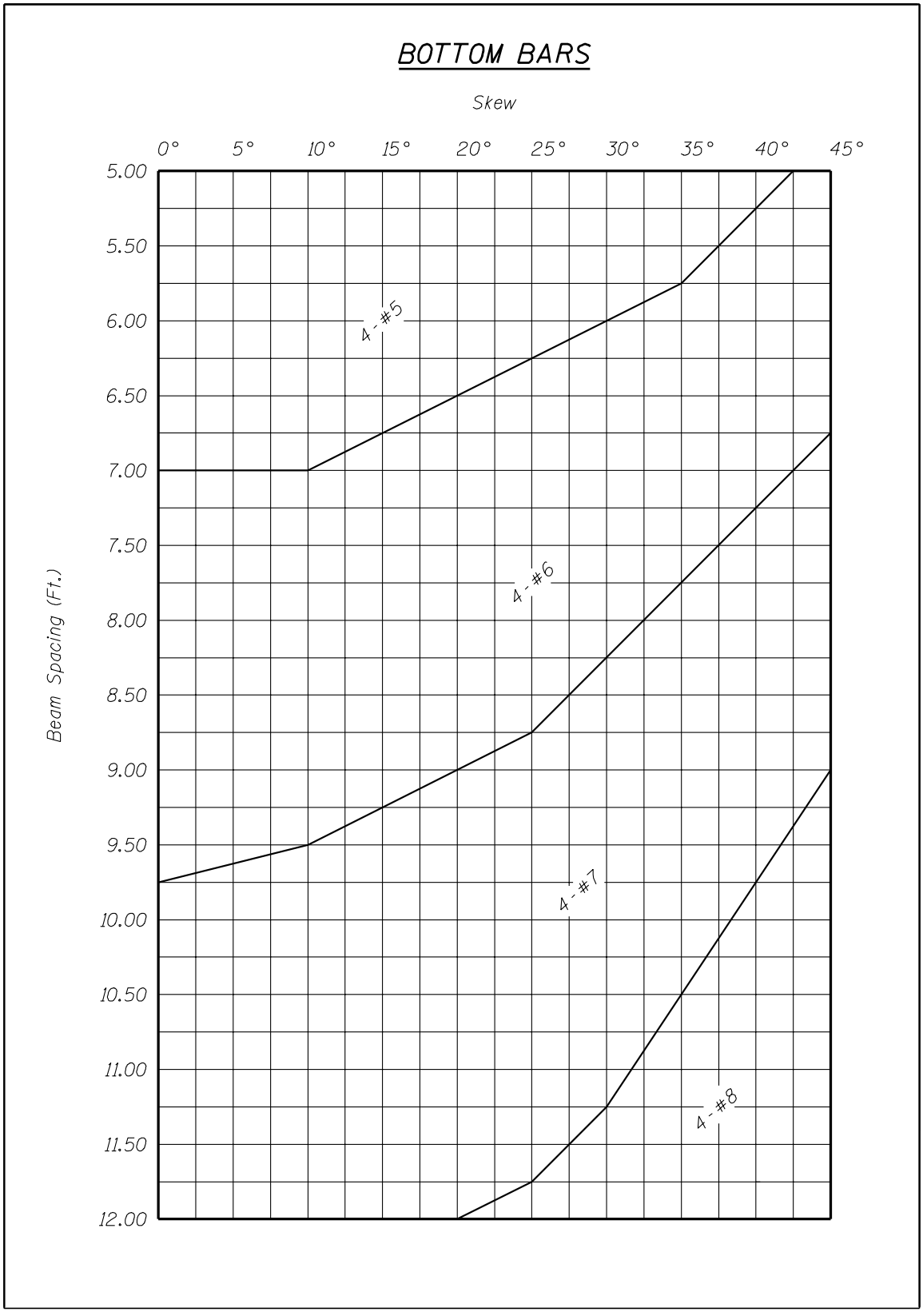
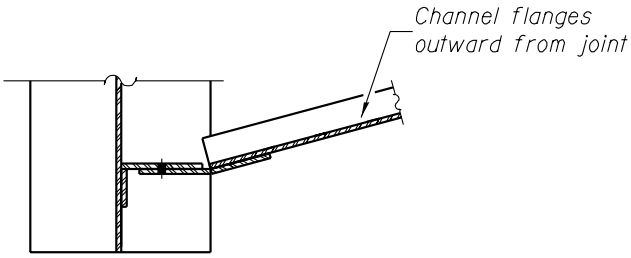
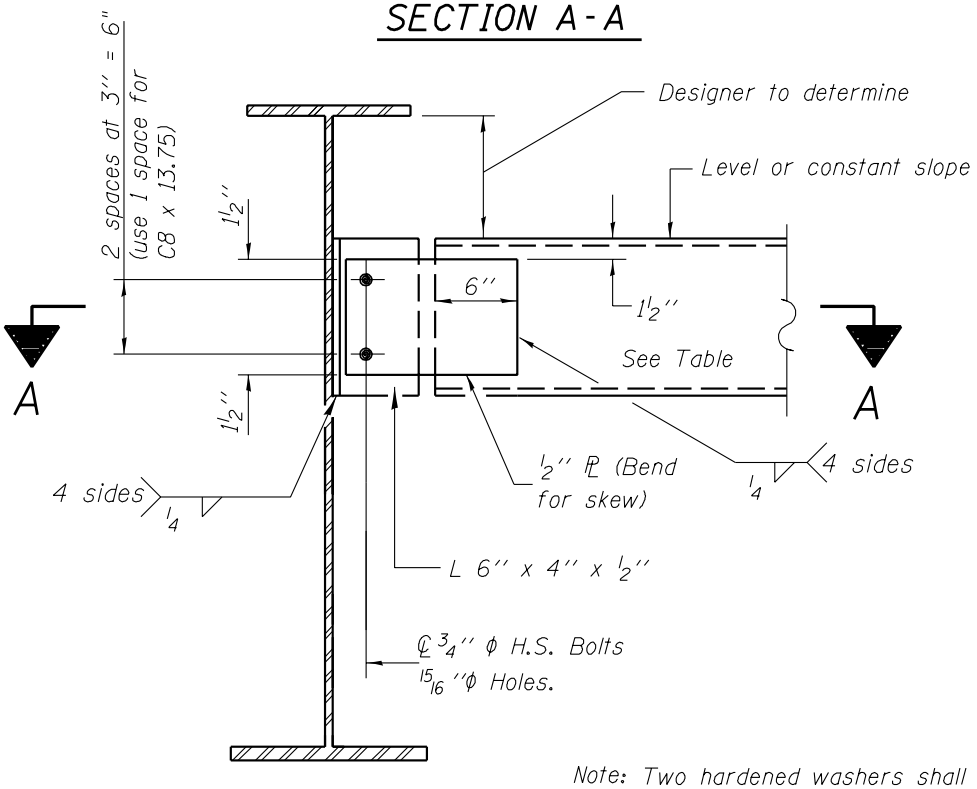

BOTTOM BARS
Skew
0°
5°
10°
15°
20°
25°
30°
35°
40°
45°
Beam Spacing (Ft.)
5.00
5.50
6.00
6.50
7.00
7.50
8.00
8.50
9.00
9.50
10.00
10.50
11.00
11.50
12.00
4 - #5
4 - #6
4 - #7
4 - #8

Figure 3

BEAM	DIAPHRAGM
W21	C8 x 13.75
W24	C8 x 13.75
W27	C10 x 20
W30	C10 x 20
W33	C12 x 25
W36	C12 x 25



SECTION A-A

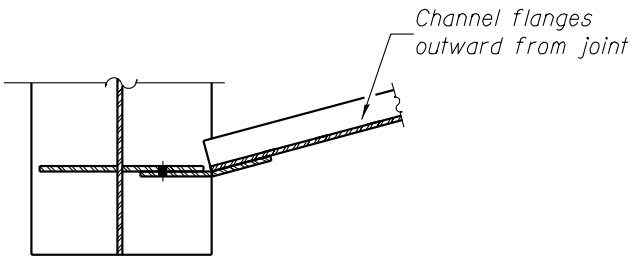


Note: Two hardened washers shall be required over all oversized holes.

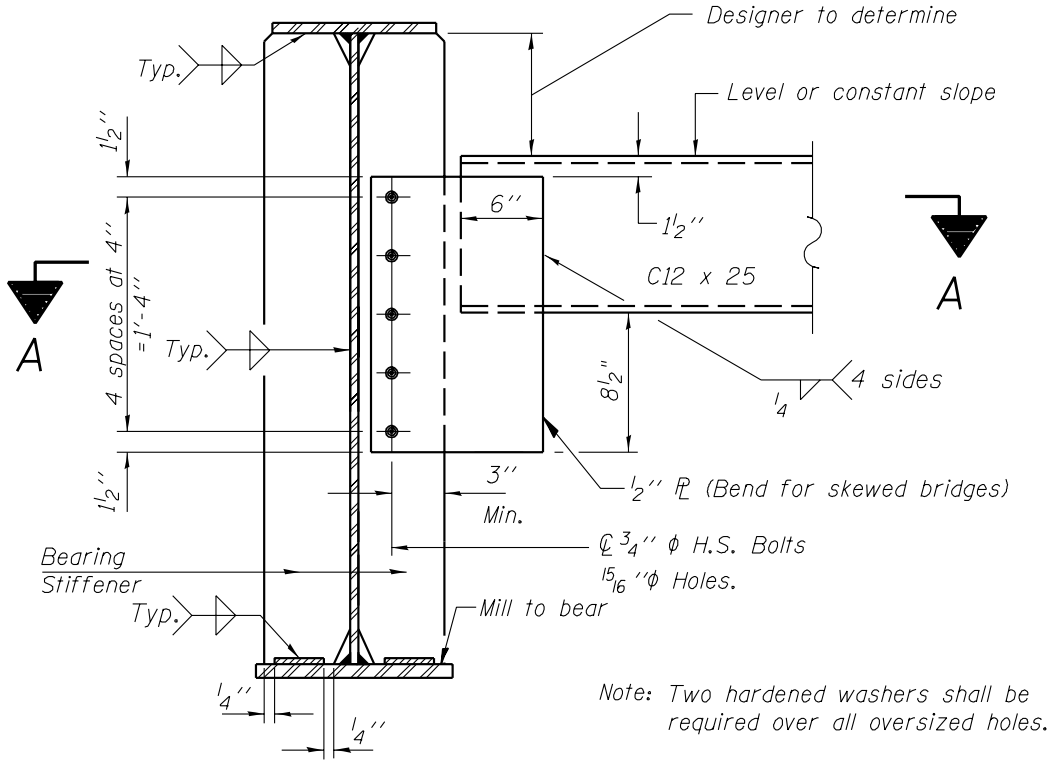
END DIAPHRAGM

END DIAPHRAGM CONNECTIONS
FOR WIDE FLANGE SECTIONS

Figure 4



SECTION A-A

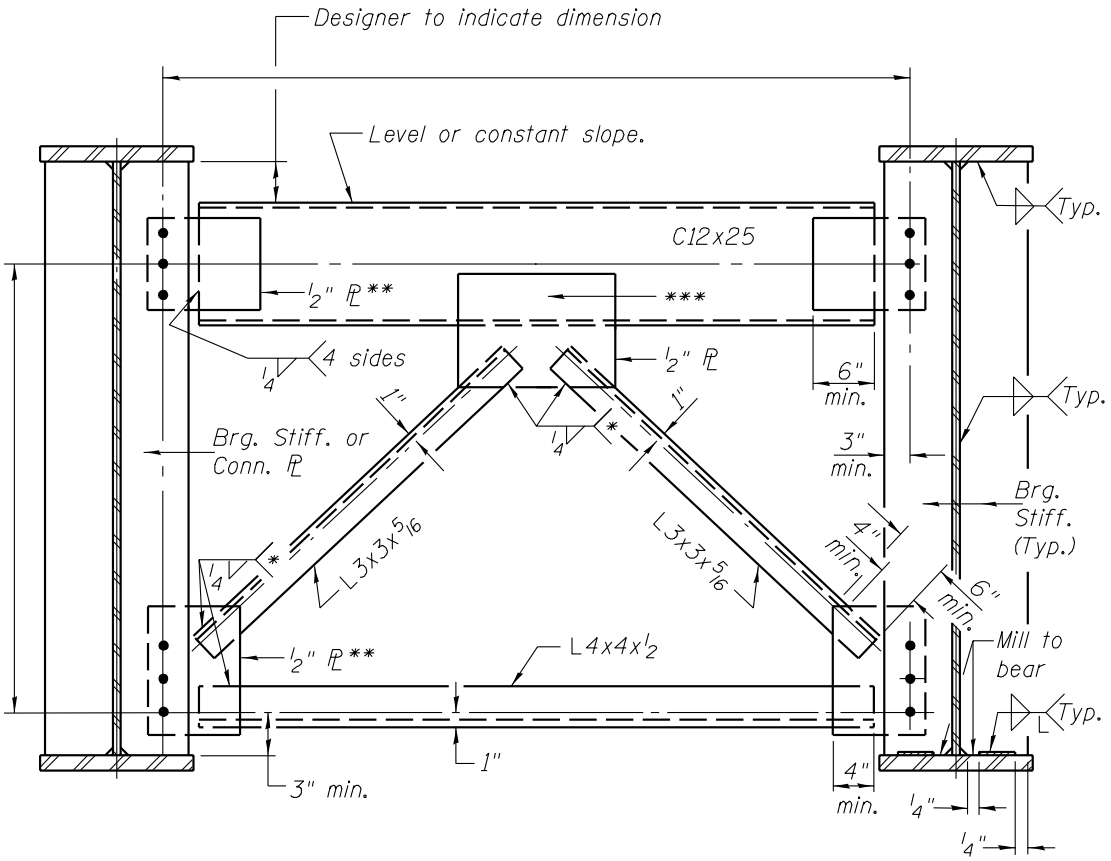


END DIAPHRAGM

(For Welded Girders 48" and smaller in depth with or without stiffeners.)

END DIAPHRAGM CONNECTIONS FOR SHALLOW PLATE GIRDERS

Figure 5



TYPICAL END CROSS FRAME

(For Welded Girders greater than 48" in depth)

Notes: Detail $15/16$"ϕ holes for all $3/4$"ϕ bolts.
$1\,1/16$"ϕ holes for all $7/8$"ϕ bolts.

Two hardened washers shall be required over all oversized holes.

Place diaphragm with channel flanges and outstanding angle legs outward from abutment backwall.

Bearing Stiffeners shall be welded to flanges when used as cross frame Connection Plates. See Section 3.3.12.

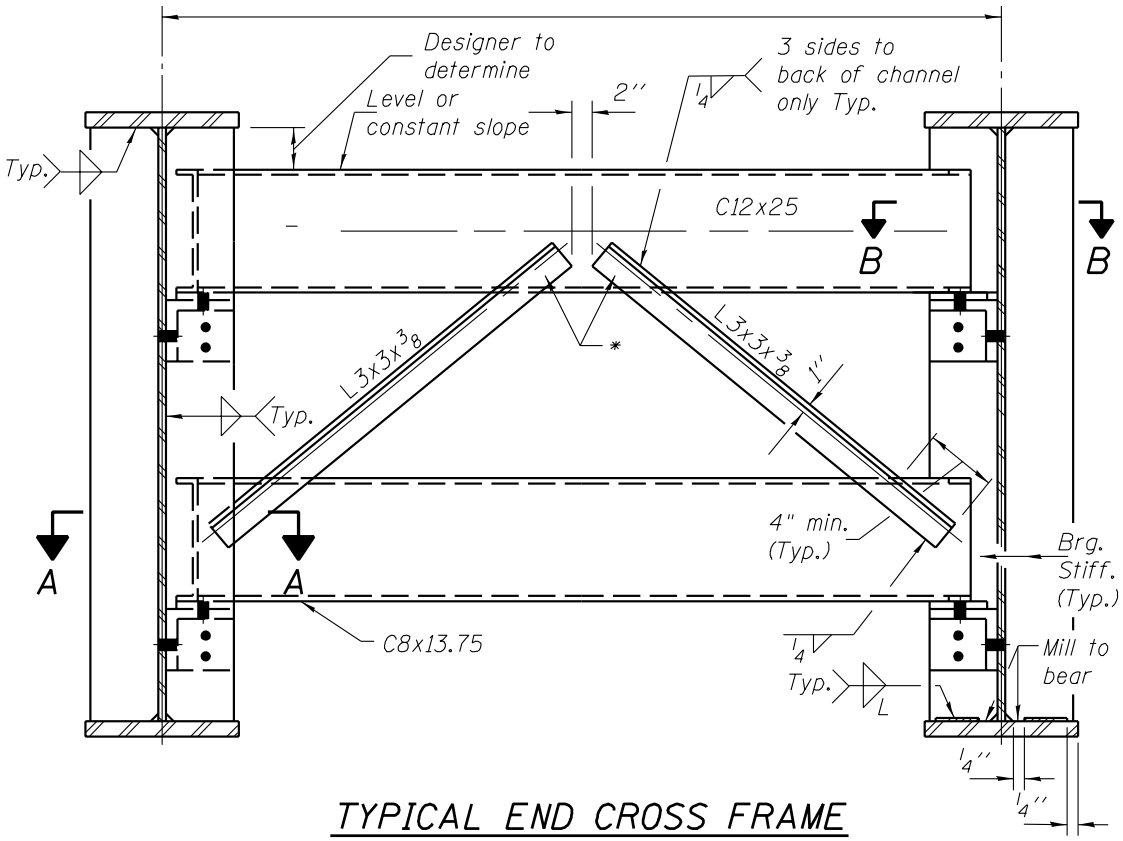
* Weld on near side of $1/2$" plate

** $1/2$'' plates to be bent for skewed structures.

*** Use bolted connection for stage construction.

END CROSS FRAME FOR SKEW<45°

Figure 6



TYPICAL END CROSS FRAME

(For Welded Girders greater than 48" in depth)

Notes: Detail $15/16$"ϕ holes for all $3/4$"ϕ bolts.
$1\,1/16$"ϕ holes for all $7/8$"ϕ bolts.

Two hardened washers shall be required over all oversized holes.

Place diaphragm with projected legs outward from abutment backwall.

* Use a minimum 2 bolt connection for stage construction.

For Sections A-A and B-B see Figure 8

END CROSS FRAME FOR SKEW ≥ 45°

Figure 7

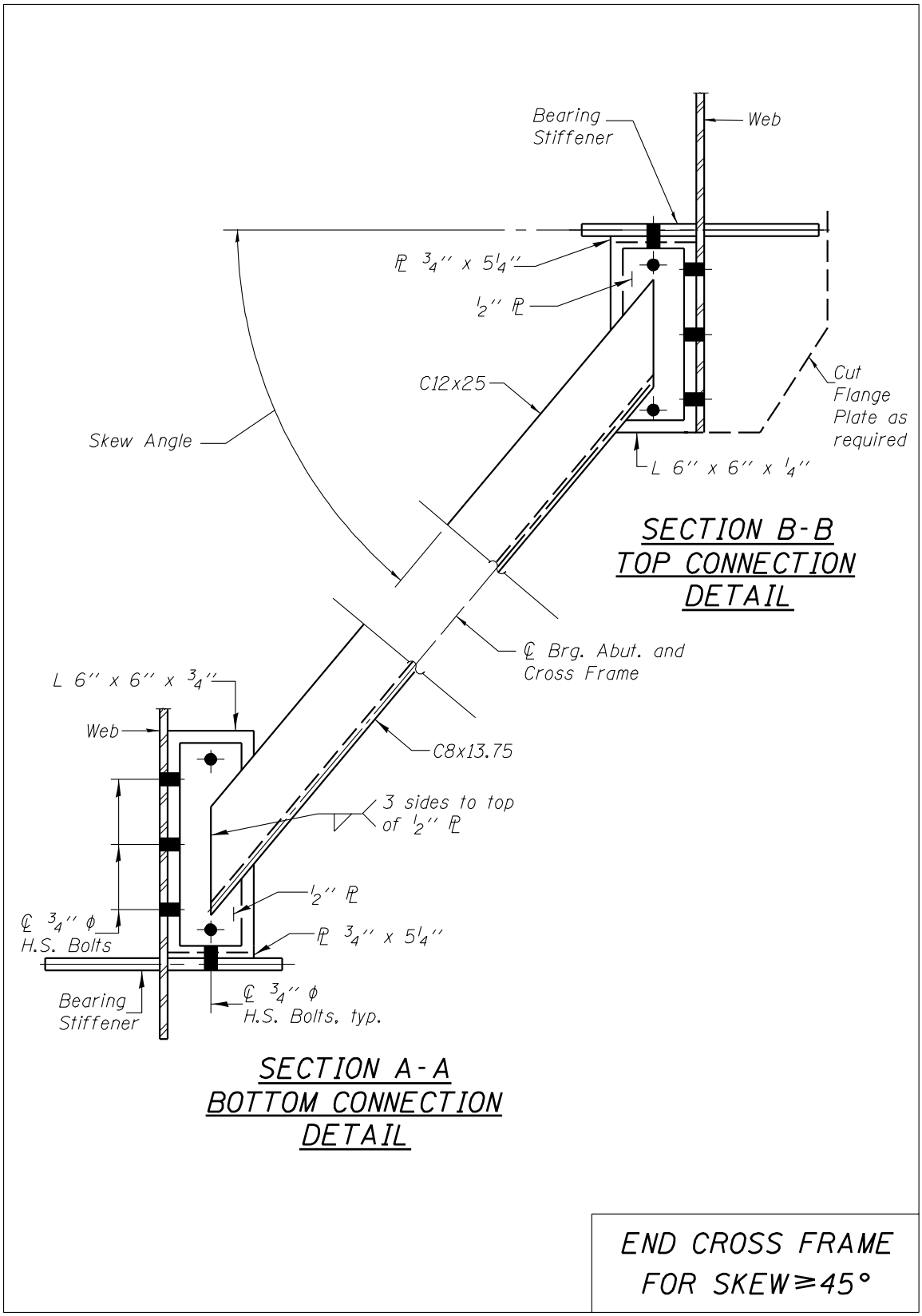
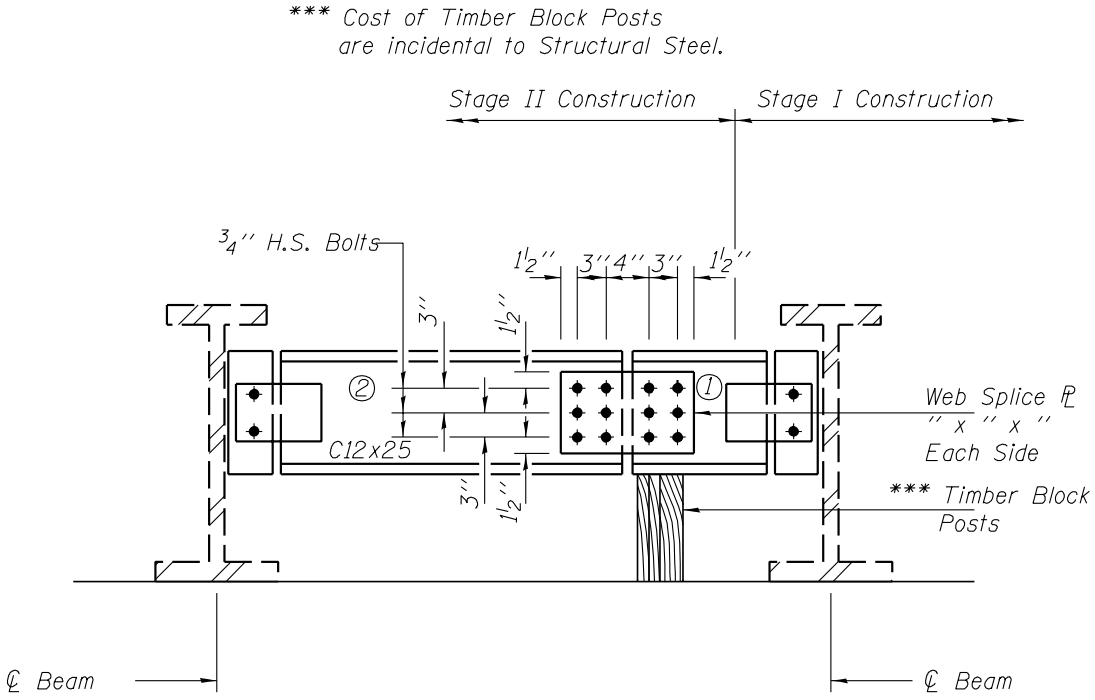

Bearing Stiffener
Web
PL 3/4'' x 5 1/4''
1/2'' PL
C12x25
Cut Flange Plate as required
Skew Angle
L 6'' x 6'' x 1/4''
SECTION B-B
TOP CONNECTION
DETAIL
℄ Brg. Abut. and Cross Frame
L 6'' x 6'' x 3/4''
Web
C8x13.75
3 sides to top of 1/2'' PL
1/2'' PL
℄ 3/4'' ϕ H.S. Bolts
PL 3/4'' x 5 1/4''
Bearing Stiffener
℄ 3/4'' ϕ H.S. Bolts, typ.
SECTION A-A
BOTTOM CONNECTION
DETAIL
END CROSS FRAME
FOR SKEW≥45°

Figure 8



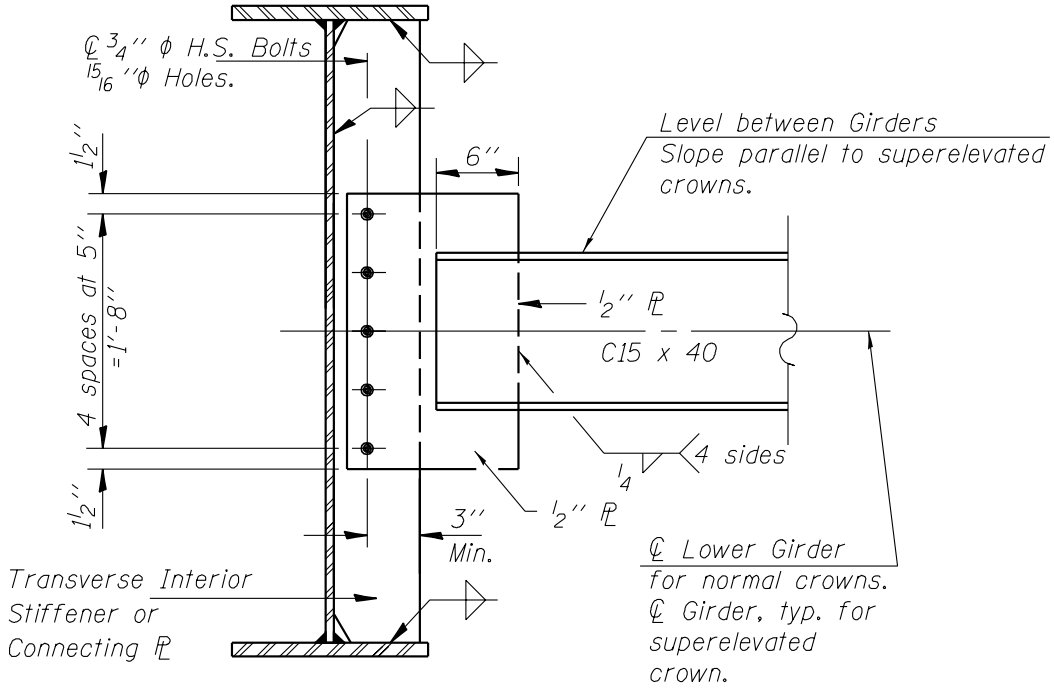
END DIAPHRAGM

END DIAPHRAGM STAGE CONSTRUCTION SEQUENCE

1.) Order Diaphragm in two sections.
2.) Attach section ① of Diaphragm to Beam .
3.) Place Timber Block Posts between section ① of diaphragm and abutment bearing section.
4.) Attach section ② of diaphragm to both Beam and section ① of diaphragm during Stage II Construction with splice plates.
5.) Remove Timber Block Posts.

END DIAPHRAGM
STAGE CONSTRUCTION
SEQUENCE

Figure 9



INTERIOR DIAPHRAGM

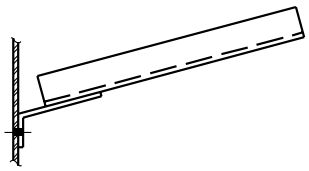
(For Welded Girders with depths of 42'' through 48'' with or without stiffeners.)

Note: Two hardened washers shall be required over all oversized holes.

DIAPHRAGM CONNECTIONS

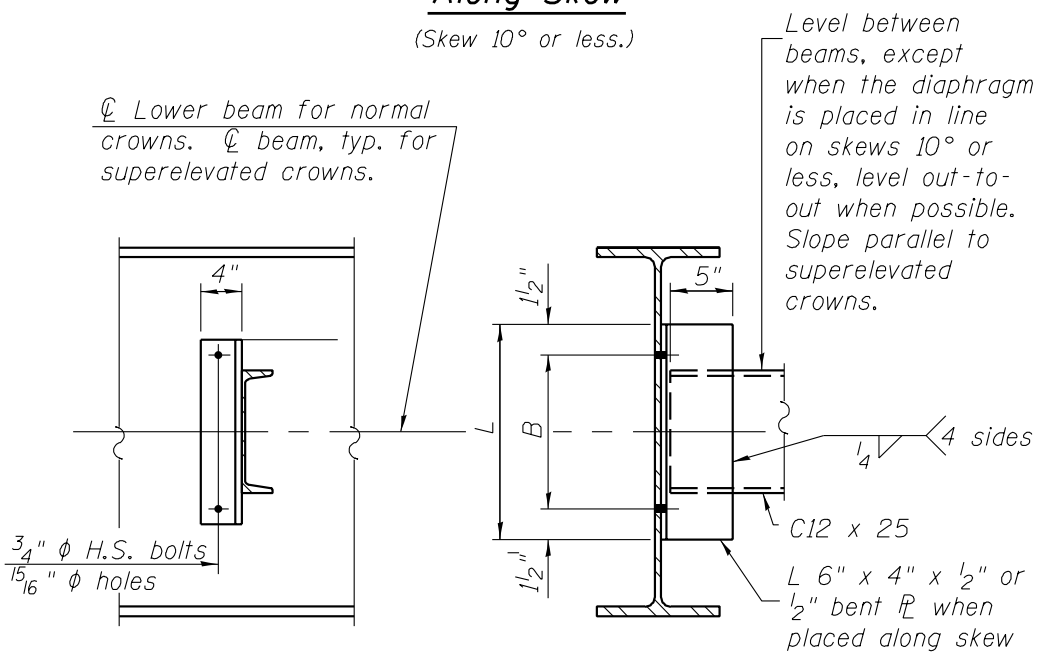
Figure 10

BEAM	L	B
W21 to W27	13"	2 spa. @ 5" cts.
W30 to W40	23"	4 spa. @ 5" cts.
℄ girders less than 42" deep	30½"	5 spa. @ 5½" cts.



Along Skew

(Skew 10° or less.)



INTERIOR DIAPHRAGM

For rolled beams and welded girders with depths up to 42".

INTERIOR DIAPHRAGM CONNECTIONS

Figure 11